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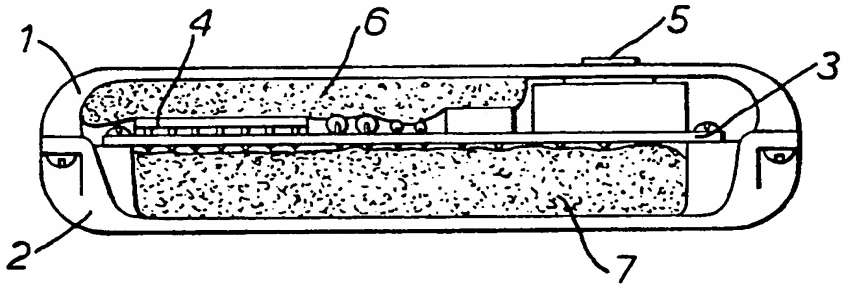
(54) Protection of electronic circuit components from static electricity

(57) Components (4, 5) on an electrical circuit board (3) which are liable to be damaged by static electricity are protected by filling at least part of the space between the circuit board (3) and a housing (1, 2) with a resilient electrically conductive material of sufficiently high resistance not to interfere with the operation of the circuit. Polyurethane foam or felt loaded with electrically conductive material such as carbon is suggested for the material.



The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

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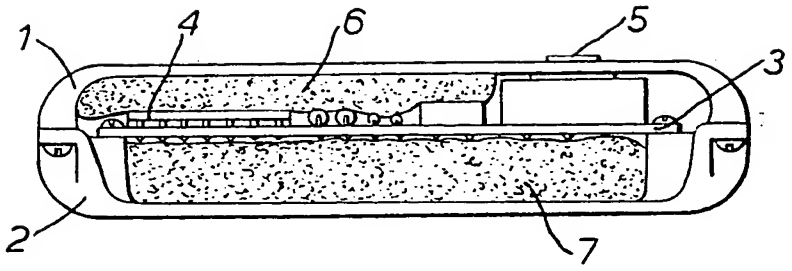

SPECIFICATION

Protection of electronic components from static electricity

This invention relates to the production of electronic components from static electrical discharges such as might be produced as a result of friction on electrically insulating materials.

Many electronic devices now incorporate integrated circuits which include a large number of insulated gate field effect transistors formed on a single chip of semiconductor material such as silicon. The transistors in such a circuit are of extremely small physical dimensions so that the required circuit can be produced on as small an area of semiconductor material as possible, and in the interests of speed of operation of the parts of the circuit and obtaining adequate gain from the individual transistors, the insulating layer between the gate electrodes of the transistors and the channels between the sources and drains is extremely thin and often the thickness is measurable in only tens of Angstrom units. Such thin insulating layers can of course be ruptured by quite small potential differences across them, and since the circuit capacitances of an integrated circuit are also very small in the interests of speed of operation, it follows that an integrated circuit could be damaged by even such small static electrical discharges as will be produced by friction on an insulating material such as a synthetic resin. For this reason particular precaustions are taken when transporting integrated circuits whilst they are not connected to the other components of the electronic device for which they are intended. Amongst the kinds of protection which have been employed are the use of electrically conducting tubing in which the components are carried and electrically conducting resilient foam material such as polyurethane loaded with carbon into which the terminals (legs) of the integrated circuit are pressed. It has, however, been found that the operation of certain electronic equipment can be influenced by static electrical discharges even though permanent damage to the integrated circuits does not occur because of the loading of the other components on the connections of the integrated circuit. For example, the use of antistatic strays is common in offices containing electronic computers because it has been found that spurious data can be stored in the computer as a result of the electrical discharges.

It is an object of the present invention to protect electronic circuits the operation of which can be upset by static electrical discharges.

According to one aspect of the present invention there is provided a method of protecting components from the effects of static electricity, the components being part of a circuit attached to a circuit board which is mounted in a housing of such material as can accumulate static electrical charge, in which at least part of the space being the printed circuit board and the housing is filled with a resilient electrically conductive material of resistivity high enough not to interfere significantly with the operation of the circuit and low enough to discharge static electrical charges which might otherwise accumulate.

According to a second aspect of the invention there is provided an assembly including an electrical circuit on a circuit board in a housing of such material as can accumulate a static electrical charge, the circuit having at least one component which can be affected by static electricity, wherein at least part of the space between the circuit board and the housing is filled with a resilient electrically conductive material of resistivity high enough not to interfere significantly with the operation of the circuit and low enough to discharge static electrical charges which might otherwise accumulate.

The resilient electrically conductive material may be, for example, polyurethane foam impregnated with carbon of such particle size and in such quantity as to produce the required resistivity. Another suitable material would be felt of natural or synthetic material impregnated or coated with electrically conducting particles, for example, of carbon.

In order that the invention may be fully understood and readily carried into effect an example will now be described with reference to the single figure of the accompanying drawing, which shows a side view partly in cross-section of a hypothetical electronic device.

The device shown has a housing made of two parts, 1 and 2, of plastics material joined by screws. A printed circuit board 3 is secured to the part 2 and bears amongst other components an integrated circuit 4 and a component 5 providing a control external to the housing. In accordance with the invention, the interior of the housing is approximately filled with pieces 6 and 7 of a resilient electrically conductive material such as polyurethane foam impregnated with carbon. As will be evident from the drawing, the piece 7 touches the soldered joints on the underside of the printed circuit board 3, and in order that the resistive connections provided between these soldered joints by the material of the piece 7 shall not interfere with the functioning of the electronic circuit on the board 3, it is necessary that the resistivity of the material of the piece 7 shall be of sufficiently high value. On the other hand, the resistivity of the material of the pieces 6 and 7 must be sufficiently low to discharge any static electrical charges accumulated on the material of the housing, for example, as a result of friction whilst the

device is being handled. It is not necessary for the whole of the space between the circuit board 3 and the housing parts 1 and 2 to be filled with the resilient electrically conductive material providing that the parts of the circuit connected to the integrated circuit 4 and the integrated circuit 4 itself are protected from static electrical discharges. In particular, in the example shown in the figure the piece 7 is much more effective than the piece 6 in protecting the circuit from static electricity, so that the piece 7 may be sufficient on its own.

Although the invention is of particular value in connection with portable electronic devices, it may also be applied to larger devices such as computers where the operator may carry a static electrical charge to the device as a result of walking across a carpet of synthetic material, for example.

CLAIMS

1. A method of protecting components from the effects of static electricity, the components being part of a circuit attached to a circuit board which is mounted in a housing of such material as can accumulate static electrical charge, in which at least part of the space between the printed circuit board and the housing is filled with a resilient electrically conductive material of resistivity high enough not to interfere significantly with the operation of the circuit and low enough to discharge static electrical charges which might otherwise accumulate.

2. A method according to claim 1, wherein the resilient electrically conductive material is polyurethane foam or felt composed of natural of synthetic fibres impregnated or coated with electrically conductive particles, e.g. of carbon.

3. An assembly including an electrical circuit on a circuit board in a housing of such material as can accumulate a static electrical charge, the circuit having at least one component which can be affected by static electricity, wherein at last part of the space between the circuit board and the housing is filled with a resilient electrically conductive material of resistivity high enough not to interfere significantly with the operation of the circuit and low enough to discharge static electrical charges which might otherwise accumulate.

4. An assembly according to claim 3, wherein the resilient electrically conductive material is polyurethane foam or felt composed of natural or synthetic fibres impregnated or coated with electrically conductive particles, e.g. of carbon.

5. A method according to claim 1 or 2 or an assembly according to claim 3 or 4 wherein the resilient electrically conductive material is provided only over the side of the circuit board opposite to that on which the component or components of the circuit are mounted.

6. An assembly including an electrical circuit on a circuit board substantially as described herein with reference to the accompanying drawing.

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